

RESISTANCE OF SMALL PLATES IN A STREAM OF FLUID.¹

By LORD RAYLEIGH.

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In a recent paper on æolian tones [see preceding abstract] the author had occasion to determine the velocity of wind from its action upon a narrow strip of mirror, the incidence being normal. But there was some doubt as to the coefficient to be employed in deducing the velocity from the density of the air and the force per unit area. Observations both by Eiffel and by Stanton had indicated that the resultant pressure (force per unit area) is less on small plane areas than on larger ones; and although the author used provisionally a diminished value of C in the equation $P = C\rho V^2$ in view of the narrowness of the strip, it was not without hesitation; in fact, experiments had already been commenced which appeared to show that no variation in C was to be detected. Subsequently the matter was carried a little further, and the method is here described.

According to the principle of similitude a departure from the simple law would be most apparent when the kinematic viscosity is large and the stream velocity small. Thus, if the delicacy can be made adequate the use of *air* resistance and such low speeds as can be reached by walking through a still atmosphere should be favorable. The principle of the method consists in balancing the two areas to be compared by mounting them upon a vertical axis, situated in their common plane and capable of turning with the minimum of friction. If the areas are equal, their centers must be at the same distance (on opposite sides) from the axis. When the apparatus is carried forward through the air, equality of mean pressures is witnessed by the plane of the obstacles assuming a position of perpendicularity to the line of motion. If in this position the mean pressure on one side is somewhat deficient, the plane on that side advances against the relative stream until a stable balance is attained in an oblique position, in virtue of the displacement (forward) of the centers of pressure from the centers of figure.

Several arrangements were tested, viz, rectangular strips of equal area, one three times the breadth of the other; circular disks of area 2:1, one disk and two others of total area equal to the first. No deviation from the simple law was detected.—*E. H. Barton*.

SELECTED BIBLIOGRAPHY OF FROST IN THE UNITED STATES.

By WILLIAM GARDNER REED and CORA L. FELDKAMP.

[Dated Office of Farm Management, Washington, Nov. 1, 1915.]

INTRODUCTION.

This bibliography has been selected² from all the material on frost and frost prevention under American conditions which has come to the attention of the writers. This includes all the material in the classed bibliographies of the John Crerar Library (Chicago), the Library of Congress, the Library of the United States Department of Agriculture, the Weather Bureau Library, and the Library of the Bureau of Plant Industry, as well as ref-

rences in the MONTHLY WEATHER REVIEW, the Experiment Station Record, and various other agricultural and meteorological publications.

It is believed to cover the subject adequately, but is in no sense a complete bibliography of the published material on frost. It is arranged with the later papers first as most of the work is very recent. Earlier papers have usually not been included when later papers cover substantially the same ground.

The papers marked with asterisks (*) form a group which will give a more or less complete idea of the frost problem and the methods of protecting against frost damage. A series of papers³ on frost appears in the MONTHLY WEATHER REVIEW, October, 1914; there is also a more popular series in Better Fruit (Hood River, Oreg.), volume 5, number 4, October, 1910.

The State index is an attempt to show the work which has been done in the different States; it includes only papers listed in the bibliography.

FROST DATA (General).

United States Weather Bureau, Climatological Division.

Summaries of climatological data of the United States by sections (tables). Various dates.⁴

Frost data for 106 "sections" of the United States are given. These summaries are continually brought down to date as the issue for each section is exhausted. In the summaries printed before 1914 the summaries give the average and latest date of last killing frost in spring, and the average and earliest date of first killing frost in autumn for numerous stations in each section. In the summaries printed since 1914 the dates for each year of record are given.

1915.

Coit, J. Eliot.

Citrus Fruits (New York: Macmillan) xx+520 p., 151 fig. "Frost and orchard heating." Chap. 14: 230-276, fig. 72-95.

The more important cold periods are described. Frost forecasting and the factors affecting frost are explained. The phenomena of frosting of citrus fruits are discussed. Methods of preventing frost injury are considered under the following heads: Selection of a relatively frostless locality, using a resistant stock, breeding new resistant stocks, use of mechanical devices to conserve heat, raising the dew point, and slow thawing. Heating with oil heaters is described in detail, with descriptions of various oil pots. The necessity of cooperation is emphasized.

*McAdie, Alexander G.

Temperature inversions in relation to frosts. *Annals, Harvard College Observ.* 73: 168-177, 4 pl.

The physics of frost formation in connection with local air drainage and inversions of temperature is discussed, especially with regard to water vapor relations. The physical bases of the methods of protection are explained.

Malone, R. E.

Smudging an orchard with native material in Alabama. *Alabama Tuskegee agr. exp. sta. Bul.* 28, 13 p., tables.

The value of smudging in Alabama is briefly discussed. The experiment-station orchard and the methods of frost protection are described. Smudging material was wet peach prunings and tar. Loblolly pine makes excellent smudging material.

Smith, J. Warren.

Predicting minimum temperatures for frost protection. *Ohio naturalist*, 15: 405-408, 1 fig.

Temperature forecasting is explained and a method of obtaining minimum temperatures from the similarity during conditions favorable to frost is suggested.

1914.

Beals, Edward A.

Frost forecasts and frost protection in Oregon, Washington, and Idaho. *Mo. weather rev.* 1914, 42: 587.

Frost warnings are issued mainly for the benefit of commercial orchards in which protection is used. Forecasts have saved many crops. Orchard heating is generally practiced.

Briggs, Robert R.

Frost protection in Arizona. *Mo. weather rev.*, 1914, 42:589-590.

Frost has been little studied in this State, but the possibilities of protection in irrigated areas is becoming of increasing importance.

¹ Reprinted as W. B. No. 542, "Papers on frost and frost protection in the United States." Washington, 1915.

² These section summaries were collected as Bulletin W of the Weather Bureau in 1912. See "1912 United States Weather Bureau."

³ The papers marked with an asterisk (*) form a group which gives a general idea of the frost problem.

¹ See *Phil. mag.*, July, 1915, p. 179-181.

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